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(54) SEAL ASSEMBLY FOR A TURBOMACHINE

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F04D 29/08 (2006.01)
F01D 25/24 (2006.01)

(52) **U.S. Cl.**

CPC ***F01D 11/006*** (2013.01); ***F01D 25/246*** (2013.01); ***F04D 29/083*** (2013.01); *F05D 2240/57* (2013.01); *F05D 2250/61* (2013.01)

(58) **Field of Classification Search**

CPC . F01D 11/006; F01D 5/02; F01D 5/12; F01D 9/041; F16J 15/0887; F05D 2220/32
See application file for complete search history.

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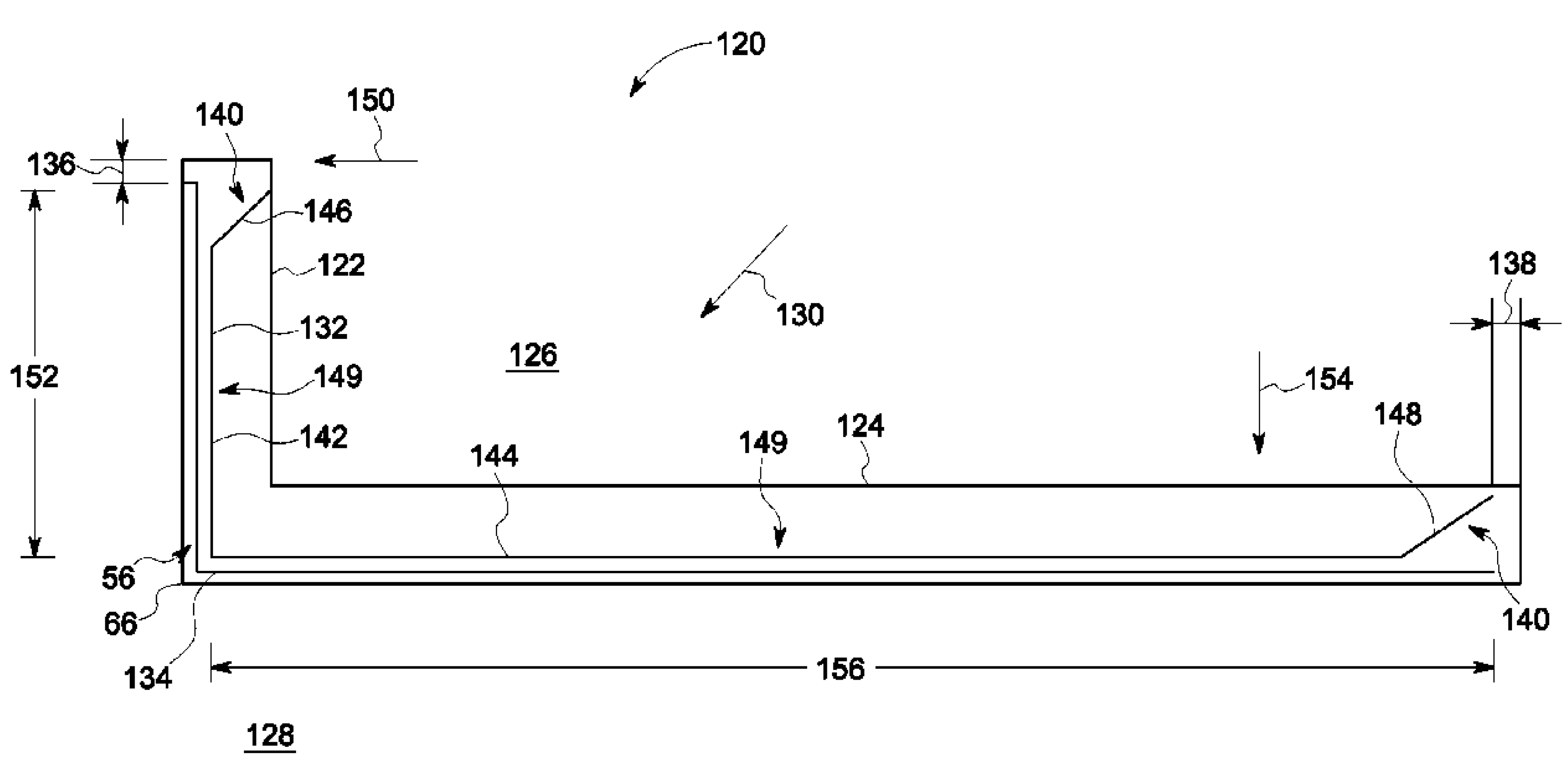
(57) **ABSTRACT**

The present disclosure relates to a turbomachine that includes a first component and a second component coupled to another and a seal assembly between the two components. The seal assembly may include an upstream corner shim and a downstream corner shim, where one of the upstream corner shim or the downstream corner shim includes a pressure actuation feature configured to block a flow of gas between the two components.

20 Claims, 7 Drawing Sheets



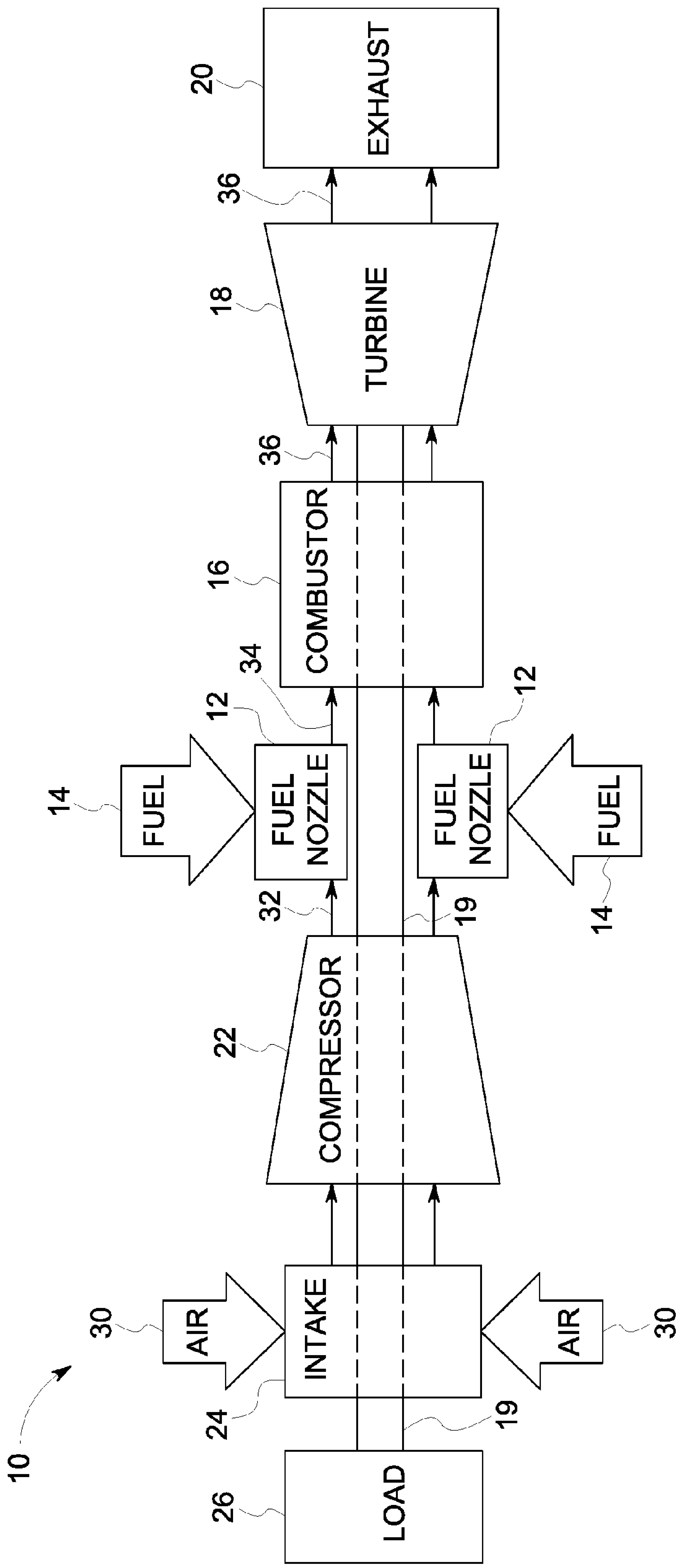

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FIG. 1

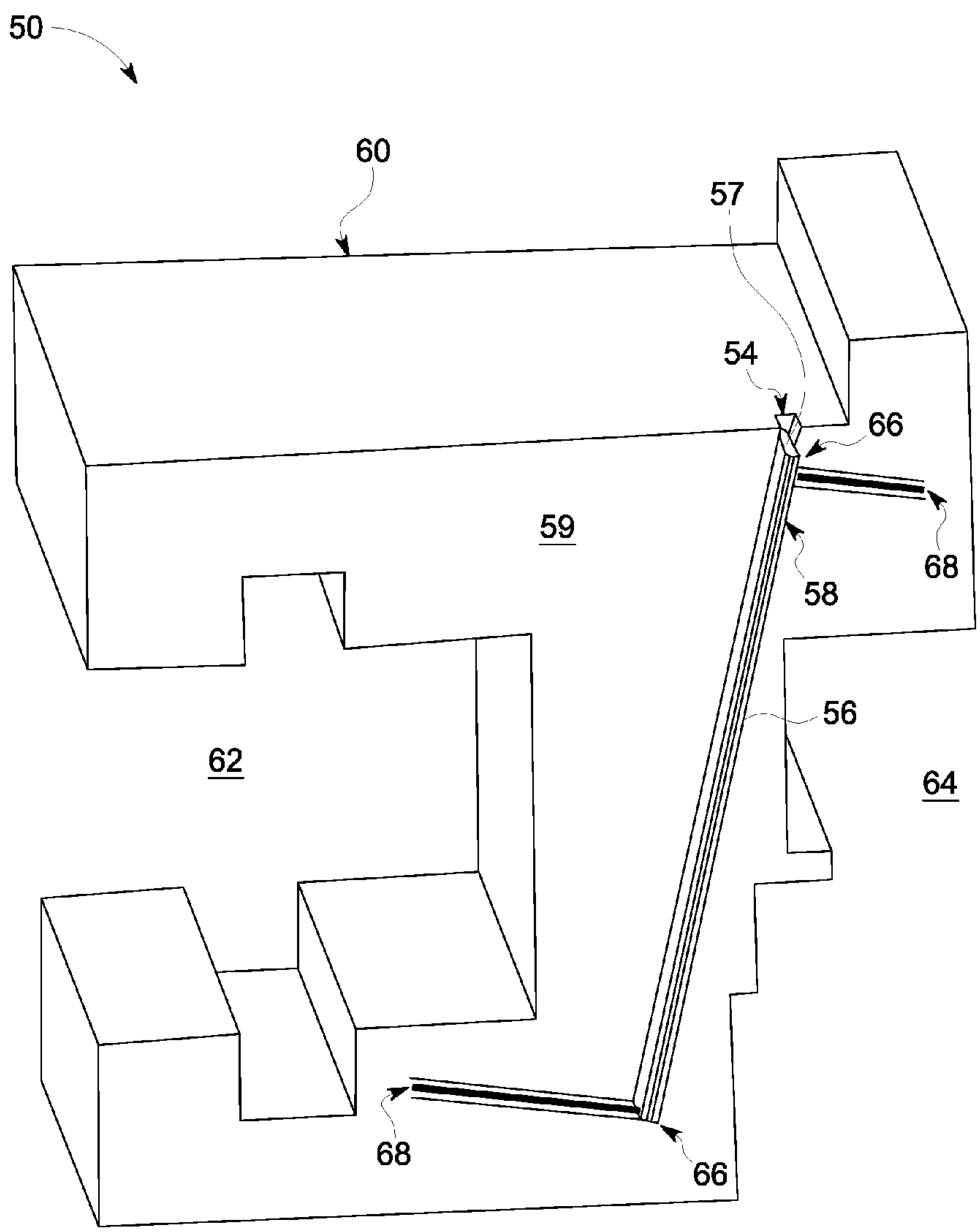

FIG. 2

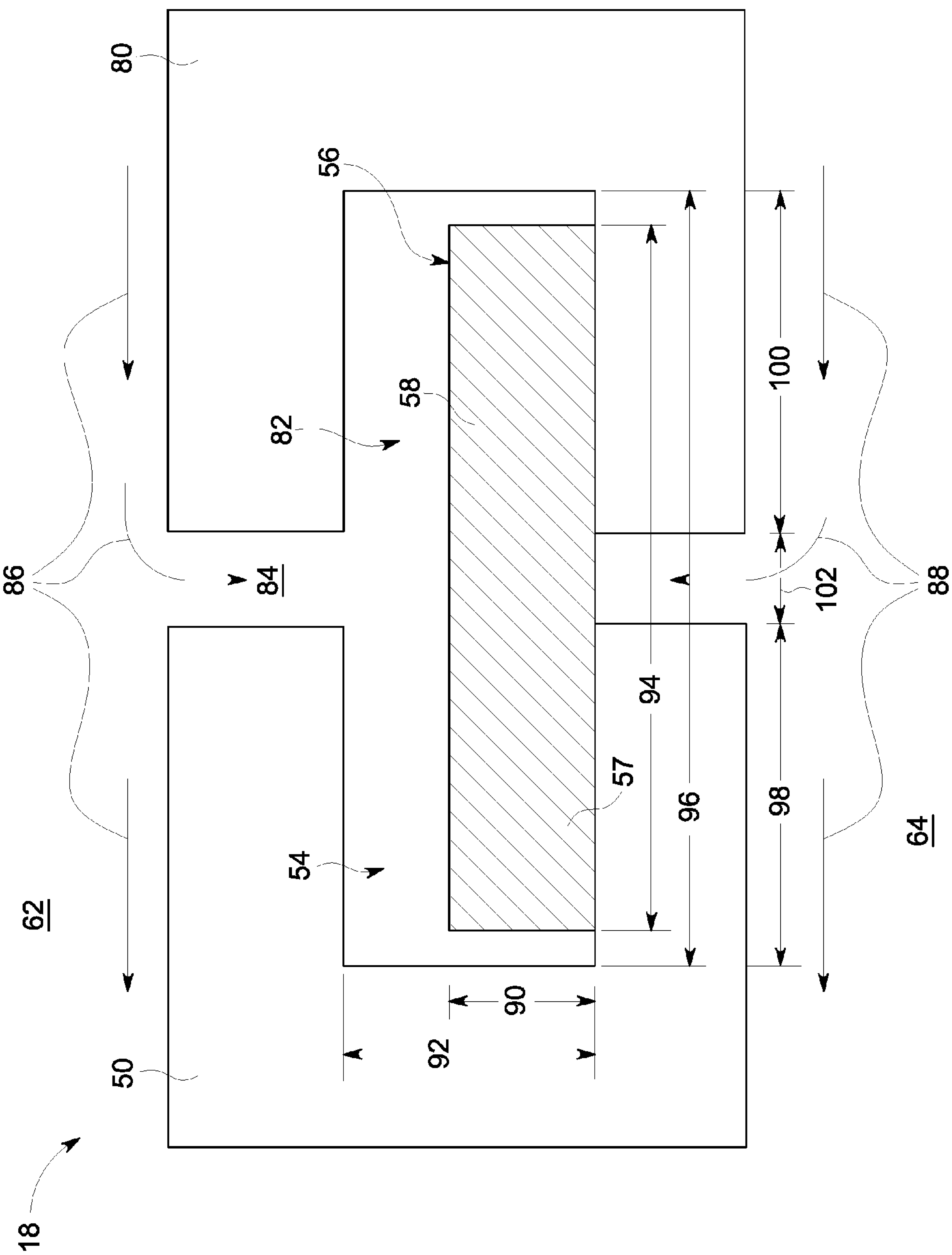

FIG. 3

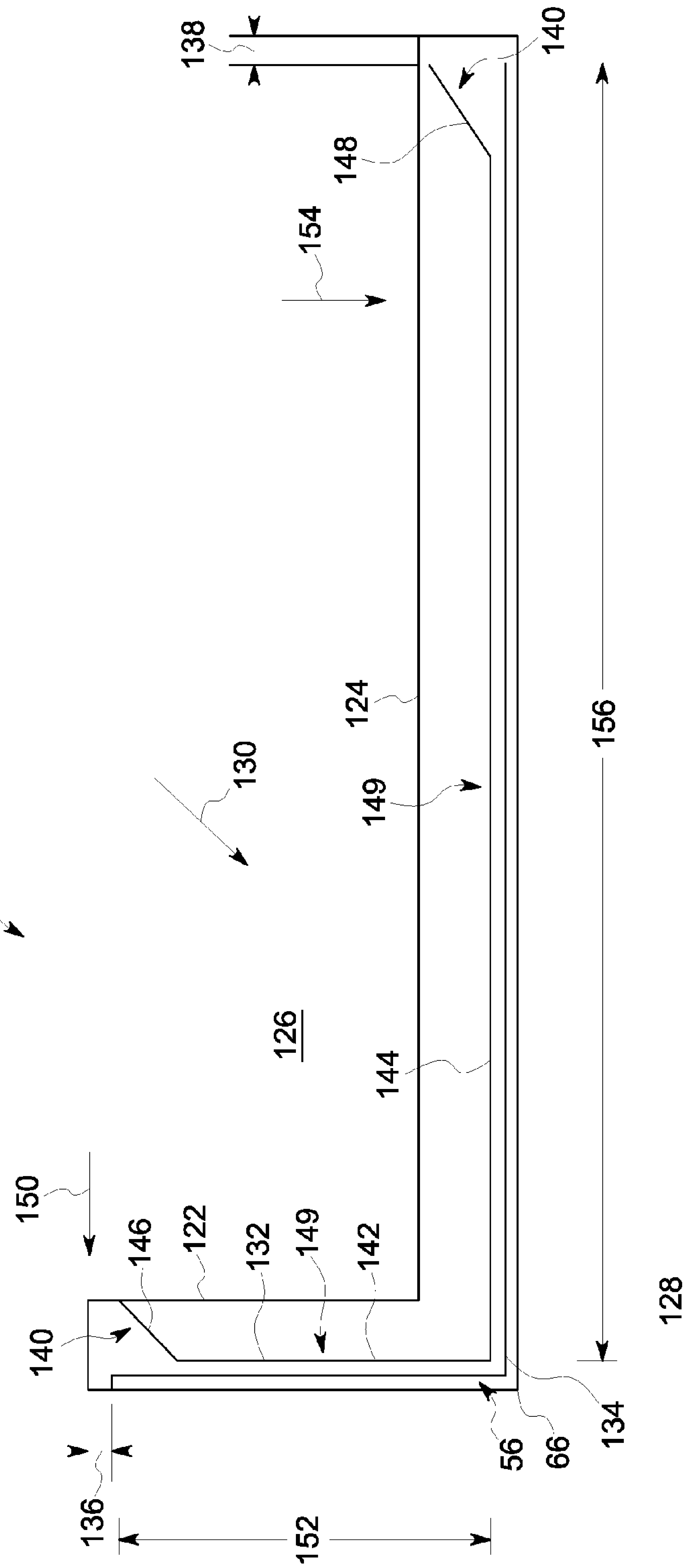
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FIG. 4

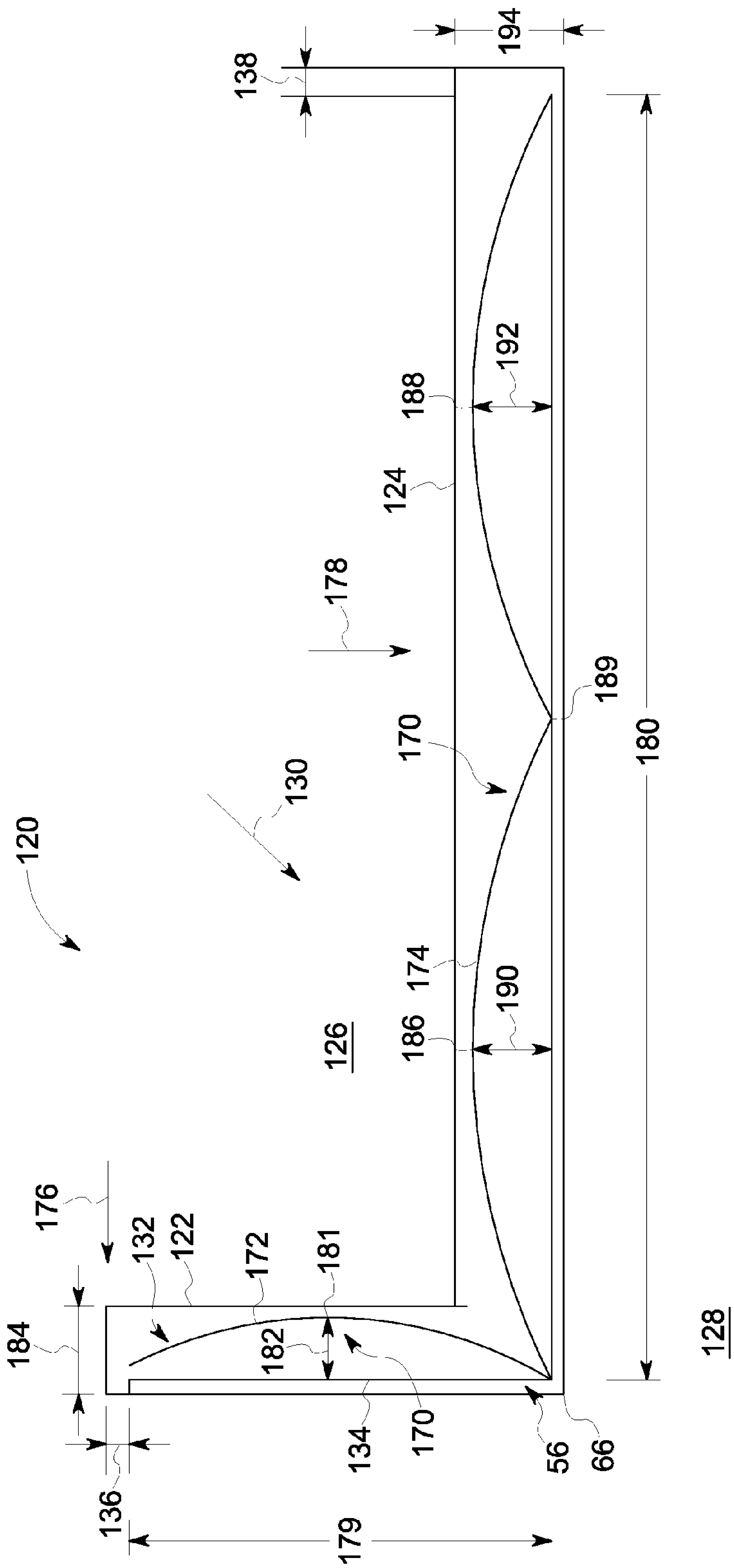
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FIG. 5

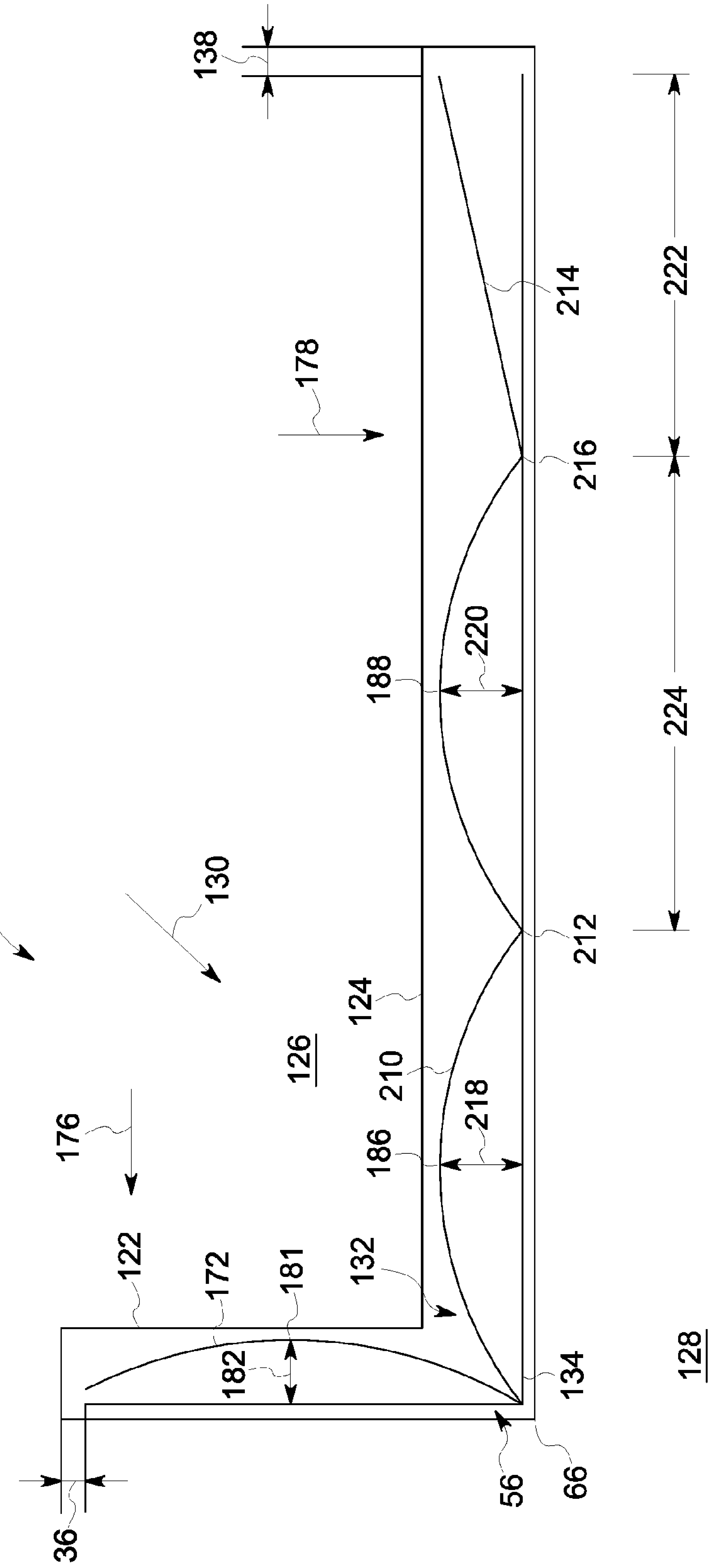
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FIG. 6

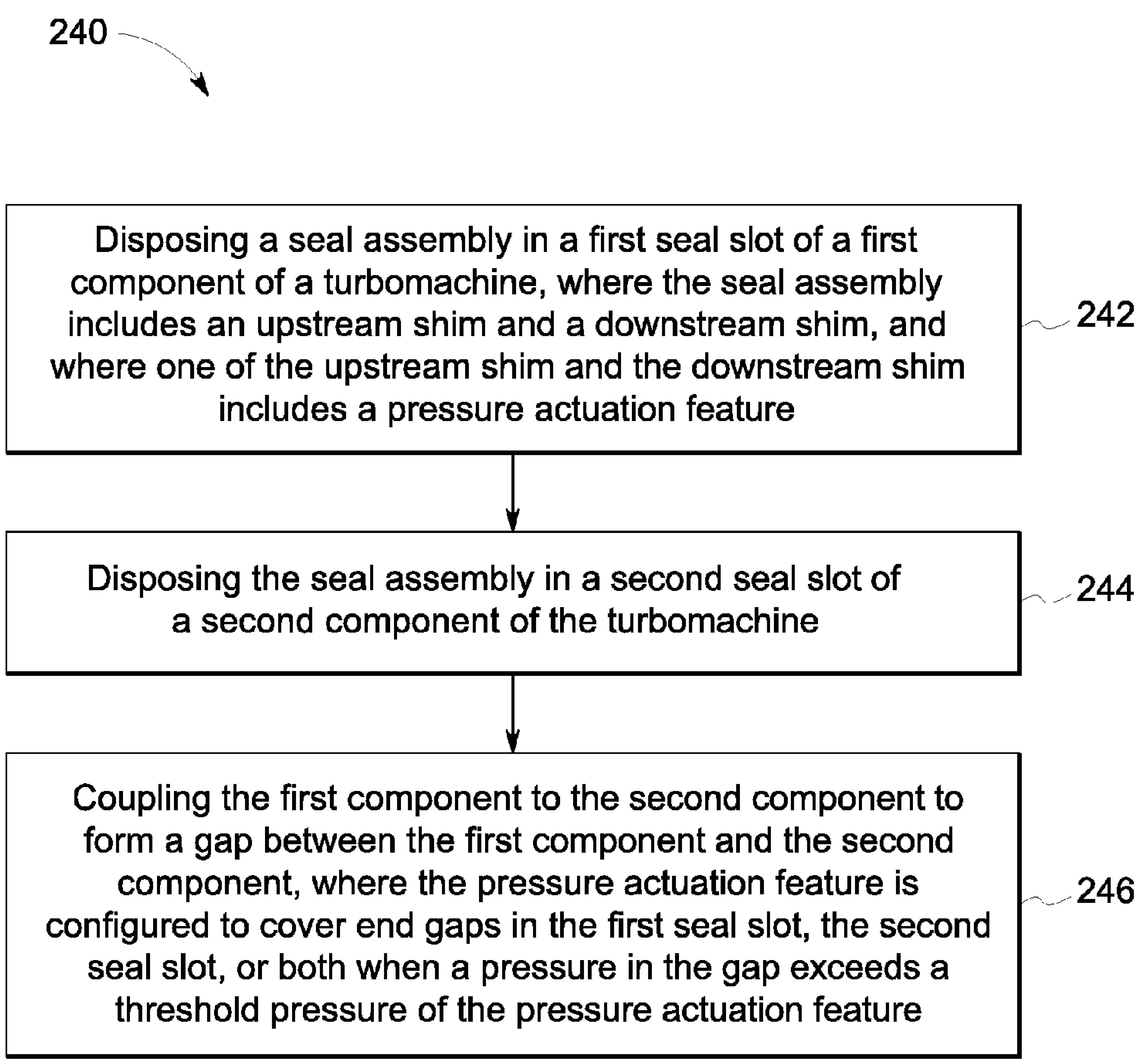
240
Disposing a seal assembly in a first seal slot of a first component of a turbomachine, where the seal assembly includes an upstream shim and a downstream shim, and where one of the upstream shim and the downstream shim includes a pressure actuation feature
242
Disposing the seal assembly in a second seal slot of a second component of the turbomachine
244
Coupling the first component to the second component to form a gap between the first component and the second component, where the pressure actuation feature is configured to cover end gaps in the first seal slot, the second seal slot, or both when a pressure in the gap exceeds a threshold pressure of the pressure actuation feature
246

FIG. 7

SEAL ASSEMBLY FOR A TURBOMACHINE

BACKGROUND

The subject matter disclosed herein relates to turbomachines, and more specifically to a sealing assembly between portions of a turbomachine component.

A variety of turbomachines, such as turbines and compressors, may include seals disposed between segments. For example, a gas turbine may include stationary portions (e.g., stators) arranged circumferentially about a rotor. Unfortunately, the segments may experience thermal expansion and contraction, vibration, bending, and other forces, which can reduce the effectiveness of traditional seals. Furthermore, traditional seals between stationary portions may experience substantial pressure differences between different fluid flows, such as a hot gas flow driving the turbine blades and a coolant air flow for cooling the segments. As a result, traditional seals may experience leakage, which can reduce performance and reliability of the turbomachine (e.g., gas turbine). Accordingly, it is now recognized that an enhanced seal is desired.

BRIEF DESCRIPTION

In one embodiment, a turbomachine includes a first component that has a first seal slot with a first corner, a second component coupled to the first component, where the second component includes a second seal slot with a second corner. The turbomachine also includes a gap between the first component and the second component and a seal assembly disposed in the first component, the second component, and a portion of the gap. The seal assembly includes a first corner shim and a second corner shim, where the first shim includes a pressure actuation feature configured to cover end gaps in the first seal slot, the second seal slot, or both when a pressure in the gap exceeds a threshold biasing force of the pressure actuation feature.

In another embodiment, a power generation system includes a turbomachine, a first component of the turbomachine that has a first seal slot, where the first seal slot includes a first segment and a second segment coupled to one another by a first corner, a second component of the turbomachine coupled to the first component, where the second component includes a second seal slot, and the second seal slot has a third segment and a fourth segment coupled to one another by a second corner. The power generation system also includes a gap between the first component and the second component and a seal assembly disposed in the first seal slot, the second seal slot, and a portion of the gap. The seal assembly includes a first corner shim disposed in the first segment, the second segment, the third segment, and the fourth segment and a second corner shim disposed in the first segment, the second segment, the third segment, and the fourth segment. The second corner shim includes a pressure actuation feature configured to cover end gaps in the first seal slot, the second seal slot, or both when a pressure in the gap exceeds a threshold biasing force of the pressure actuation feature.

In another embodiment, a method includes disposing a first portion of a seal assembly in a first seal slot of a first component of a turbomachine, where the seal assembly includes a first corner shim and a second corner shim, and the first corner shim includes a pressure actuation feature. The method also includes disposing a second portion of the seal assembly in a second seal slot of a second component of the turbomachine and coupling the first component to the second component to form a gap between the first component and the second component. The pressure actuation feature is configured to cover end gaps in the first seal slot, the second seal slot, or both when a pressure in the gap exceeds a threshold biasing force of the pressure actuation feature.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features, aspects, and advantages of the present disclosure will become better understood when the following detailed description is read with reference to the accompanying drawings in which like characters represent like parts throughout the drawings, wherein:

FIG. **1** is a block diagram of an embodiment of a gas turbine system, in accordance with an aspect of the present disclosure;

FIG. **2** is a perspective view of a component of the turbine system of FIG. **1** that includes a seal assembly disposed in a seal slot, in accordance with an aspect of the present disclosure;

FIG. **3** is a cross-section of a portion of the turbine of the turbine system of FIG. **1** that includes a seal assembly disposed between the component of FIG. **2** and an additional component coupled to the component, in accordance with an aspect of the present disclosure;

FIG. **4** is a block diagram of an embodiment of the seal assembly of FIGS. **2** and **3** that includes a corner shim having a pressure actuation feature that includes deformable features of the upstream corner shim, in accordance with an aspect of the present disclosure;

FIG. **5** is a block diagram of an embodiment of the seal assembly of FIGS. **2** and **3** that includes a corner shim having a pressure actuation feature that includes a corrugated vertical portion and a single-corrugated horizontal portion, in accordance with an aspect of the present disclosure;

FIG. **6** is a block diagram of an embodiment of the seal assembly of FIGS. **2** and **3** that includes a corner shim having a pressure actuation feature that includes a corrugated vertical portion and a dual-corrugated horizontal portion, in accordance with an aspect of the present disclosure; and

FIG. **7** is a block diagram of a process that may be used to manufacture the turbine of FIG. **3** that includes the seal assembly of FIGS. **4-6**, in accordance with an aspect of the present disclosure.

DETAILED DESCRIPTION

One or more specific embodiments will be described below. In an effort to provide a concise description of these embodiments, all features of an actual implementation may not be described in the specification. It should be appreciated that in the development of any such actual implementation, as in any engineering or design project, numerous implementation-specific decisions must be made to achieve the developers' specific goals, such as compliance with system-related and business-related constraints, which may vary from one implementation to another. Moreover, it should be appreciated that such a development effort might be complex and time consuming, but would nevertheless be a routine undertaking of design, fabrication, and manufacture for those of ordinary skill having the benefit of this disclosure.

When introducing elements of various embodiments of the present invention, the articles "a," "an," "the," and "said" are intended to mean that there are one or more of the elements. The terms "comprising," "including," and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements. Furthermore, any numerical examples in the following discussion are intended to be non-limiting, and thus additional numerical values, ranges, and percentages are within the scope of the disclosed embodiments.

Power generation systems may include turbomachines (e.g., compressors and/or turbines) that may be utilized to ultimately power a load (e.g., a power plant). Turbomachines include elements that may move (e.g., rotate) or remain substantially stationary with respect to a shaft utilized to drive the load. For example, a turbomachine may include rotors (e.g., components that rotate about the shaft) and stators (e.g., components that remain substantially stationary with respect to the shaft). In some cases, the turbomachine may be formed from multiple components that are coupled to one another. However, coupling the components together may form one or more gaps between components, which may enable fluid (e.g., gas) to flow through the components. It may be undesirable for fluid to flow between the components because it may reduce an efficiency of the turbomachine. For example, hot combustion gases may contact a first side of a component and a cooling fluid may contact a second side of the component. The flow of combustion gases may be configured to spin the rotor and/or the shaft, which may power the load. However, the combustion gases may also increase a temperature of the component via the contact with the first side. Accordingly, the cooling fluid may contact the second side of the component to maintain the temperature of the component at a desired level during operation (e.g., when exposed to hot combustion gases). Mixing the cooling fluid and the hot combustion gases with one another may reduce a cooling efficiency of the turbomachine because the temperature of the cooling fluid may be increased, thereby leading to an increased temperature of the turbomachine component.

To separate the cooling fluid and the hot combustion gases, traditional turbomachines include seals between the components to fill the gap. Therefore, each individual component may include a seal slot configured to receive the seal. However, manufacturing tolerances may cause the seal disposed in the seal slots to leave openings that still provide a path for the cooling fluid and/or the hot combustion gases flow between two components. Therefore, it is now recognized that an enhanced seal assembly is desired to reduce leakage of the cooling fluid and/or the hot combustion gases between the components. In accordance with embodiments of the present disclosure, the seal assembly may include an upstream corner shim (e.g., a first corner shim) and a downstream corner shim (e.g., a second corner shim) where one of the upstream shim or the downstream shim includes a pressure actuated feature. Such a seal assembly may block a flow of the cooling fluid and/or the hot combustion gases through corners and/or edges of the seal slots, thereby reducing leakage and enhancing an efficiency of the turbomachine.

Turning now to the drawings and referring first to FIG. **1**, a block diagram of an embodiment of a gas turbine system **10** is illustrated. The diagram includes a fuel nozzle **12**, fuel **14**, and a combustor **16**. As depicted, the fuel **14** (e.g., a liquid fuel and/or gas fuel, such as natural gas) is routed to the turbine system **10** through the fuel nozzle **12** into the combustor **16**. The combustor **16** may ignite and combust an air-fuel mixture **34**, and then pass hot pressurized exhaust gas **36** into a turbine **18**. The exhaust gas **36** passes through turbine blades of a turbine rotor in the turbine **18**, thereby driving the turbine **18** to rotate. In accordance with present embodiments, a seal assembly that includes an upstream corner shim and a downstream corner shim may be disposed within seal slots between rotor and/or stator segments within the turbine **18** to block hot exhaust gases **36** flowing through the turbine from mixing with a cooling fluid. The coupling between blades in the turbine **18** and a shaft **19** will cause the rotation of the shaft **19**, which is also coupled to several components (e.g., a compressor **22**, a load **26**) throughout the turbine system **10**. Eventually, the exhaust gases **36** of the combustion process may exit the turbine system **10** via an exhaust outlet **20**.

In an embodiment of the turbine system **10**, compressor vanes or blades are included in the compressor **22**. Blades within the compressor **22** may be coupled to the shaft **19**, and will rotate as the shaft **19** is driven to rotate by the turbine **18**. The compressor **22** may intake air **30** into the turbine system **10** via an air intake **24**. Further, the shaft **19** may be coupled to the load **26**, which may be powered via rotation of the shaft **19**. As appreciated, the load **26** may be any suitable device that may generate power via the rotational output of the turbine system **10**, such as a power generation plant or an external mechanical load. For example, the load **26** may include an electrical generator, a propeller of an airplane, and so forth. The air intake **24** draws the air **30** into the turbine system **10** via a suitable mechanism, such as a cold air intake, for subsequent mixture of the air **30** with the fuel **14** via the fuel nozzle **12**. The air **30** taken in by the turbine system **10** may be fed and compressed into pressurized air **32** by rotating blades within the compressor **22**. The pressurized air **32** may then be fed into one or more of the fuel nozzles **12**. The fuel nozzles **12** may then mix the pressurized air **32** and the fuel **14**, to produce the air-fuel mixture **34** that is suitable for combustion (e.g., a combustion that causes the fuel **14** to more completely burn to minimize an amount of wasted fuel **14** and/or emissions in the exhaust gases **36**). As discussed above, the turbine **18** is driven by the exhaust gases **36**, and such exhaust gases may contact a first side of components of the turbine (e.g., the rotor and/or the stator). Accordingly, such segments may include a seal assembly that has one or more corner shims configured to block leakage between segments of the turbine components.

FIG. **2** is a perspective view of a component **50** (e.g., a stator portion or a rotor portion) of the turbine **18** and/or the compressor **22** that includes a seal slot **54**. In accordance with embodiments of the present disclosure, a seal assembly **56** (e.g., one or more corner shims) may be disposed in the seal slot **54** to block fluid flow between two components **50** coupled to one another. For example, a plurality of the components **50** may be coupled to one another to form a circular or cylindrical stator around the shaft **19**, for example. Accordingly, a first portion **57** of the seal assembly **56** may be disposed in the seal slot **54** of the component **50** and a second portion **58** of the seal assembly **56** may be disposed in a seal slot of a second component. It should be noted that the turbine **18** and/or the compressor **22** may include multiple components **50** that each include one or more seal slots **54** and seal assemblies **56** (e.g., each component **50** may include a seal slot **54** on a first face **59** and a second face **60**).

However, in some cases, a gap and/or opening may form when the component **50** is coupled to a second component, thereby enabling fluid (e.g., hot combustion gases and/or a cooling fluid) to flow from a first side **62** of the component **50** to a second side **64** of the component **50**. To block the fluid from flowing between the first side **62** and the second side **64**, the first portion **57** of the seal assembly **56** may be disposed in the seal slot **54** of the component **50** and the second portion **58** of the seal assembly **56** may be disposed in a second seal slot of the second component (e.g., see FIG. **3**). Additionally, as shown in the illustrated embodiment of FIG. **2**, the seal slot **54** may include one or more corners **66** to enhance the seal between the component **50** and the second component. However, existing seal assemblies may leave gaps at the corners **66** of the seal slots **54** and/or at ends **68** of the seal slot **54**. Accordingly, it is now recognized that an enhanced seal assembly **56** may minimize any leakage of fluid through the corners **66** and/or the ends **68** of the seal slot **54**. Minimizing leakage of the fluid flow between the first side **62** and the second side **64** may enhance an efficiency of the turbine system **10**. The details of the sealing assemblies **56** are further described below with reference to FIGS. **3-6**.

For example, FIG. **3** shows a cross-section of a portion of the turbine **18** and/or the compressor **22** that includes the component **50** (e.g., the first component) and a second component **80** coupled to one another (e.g., via a coupling device not shown). Additionally, the first portion **57** of the seal assembly **56** is disposed in the seal slot **54** (e.g., the first seal slot) of the first component **50** and the second portion **58** of the seal assembly **56** is disposed in a second seal slot **82** of the second component **80**. In some embodiments, the first and second components **50**, **80** may include a first nozzle of a first stator and a second nozzle of a second stator, respectively. However, it should be noted that in other embodiments, the first and second components **50**, **80** may be any other adjacent components of the turbine **18** and/or the compressor **22**. Accordingly, the seal assemblies described herein may be configured for, or used with, any number or type of components of the turbine **18** and/or the compressor **22** that may be sealed to reduce leakage between the components.

As shown in the illustrated embodiment of FIG. **3**, the first and second components **50**, **80** may be spaced from one another such that a gap **84** extends between the first and second components **50**, **80**. Accordingly, the gap **84** may enable the fluid (e.g., combustion gases and/or cooling fluid) to flow between the first and second components **50**, **80** (and from the first side **62** to the second side **64**). In some configurations, the first and second components **50**, **80** may be positioned between a first flow path **86** (e.g., a flow of hot combustion gases contacting the first side **62**) and a second flow path **88** (e.g., a flow of cooling air contacting the second side **64**). To block the first flow path **86** from mixing with the second flow path **88**, the sealing assembly **56** may be disposed in the first seal slot **54** and in the second seal slot **82**. The first and second seal slots **54**, **82** may have any size, shape, or configuration capable of receiving the seal assembly **56**. For example, as shown in the embodiment of FIG. **3**, the first and second seal slots **54**, **82** may be substantially similar to one another and adjacent to one another.

In some cases, manufacturing and assembly limitations and/or variations, as well as thermal expansion and/or movement during operation, may cause the first and second seal slots **54**, **82** to be offset, skewed, twisted, angled or otherwise misaligned. For example, the first and second seal slots **54**, **82** may include a substantially similar shape, but the relative positioning of the first and second seal slots **54**, **82** may change as a result of use, wear or operating conditions. As used herein, the term "misaligned" may include configurations where the first and second seal slots **54**, **82** are intentionally offset as well as configurations where an alignment of the first and second seal slots **54**, **82** has changed due to operating conditions of the turbine system **10**, for example. In embodiments where the seal slots **54**, **82** are offset or are likely to become offset (e.g., when the turbine system **10** operates at high temperatures), the seal assembly **56** may include a flexible material such that the seal assembly **56** may be manipulated to fit in both the first seal slot **54** and the second seal slot **82**, offset from the first seal slot **54**.

As shown in the illustrated embodiment of FIG. **3**, a thickness **90** of the seal assembly **56** may be less than a thickness **92** of the first seal slot **54** and/or the second seal slot **82**. In some embodiments, the thickness **90** of the seal assembly **56** may be between 25 mm and 150 mm, between 50 mm and 130 mm, or between 60 mm and 120 mm. Additionally, the seal assembly **56** may include a width **94** less than a width **96**, where the width **96** is the sum of a first width **98** of the first seal slot **56**, a second width **100** of the second seal slot **82**, and a third width **102** of the gap **84**.

As discussed above with reference to FIG. **2**, the first seal slot **54** and/or the second seal slot **82** may not be a simple straight groove that lies within a single plane. For example, the first seal slot **54** and/or the second seal slot **82** may include one or more of the corners **66** to provide an enhanced seal. However, traditional seals may enable leakage between the components **50**, **80** through the corners **66** and/or through end gaps of the seal slots **54**, **82**. Accordingly, enhanced configurations of the seal assembly **56** may be utilized to minimize leakage between the first component **50** and the second component **80**.

For example, FIG. **4** is a block diagram illustrating an embodiment of the seal assembly **56** configured to be disposed in a seal slot **120** having an "L" shape (e.g., a first segment and a second segment joined by a corner). While the illustrated embodiment of FIG. **4** shows the seal slot **120** having the "L" shape, it should be noted that embodiments of the presently disclosed seal assembly **56** may be configured for any suitable configuration of seal slot. Accordingly, the seal slot **120** includes the corner **66**. For example, the seal slot **120** may include a vertical portion **122** and a horizontal portion **124**, which are joined at the corner **66**. Additionally, the seal slot may separate an upstream portion **126** (e.g., the first side **62**) and a downstream portion **128** (e.g., the second side **64**) of the first component **50**. Accordingly, the upstream portion **126** may include a higher pressure than the downstream portion **128**, such that fluid may flow from the upstream portion **126** toward the downstream portion **128** in a direction **130**. In traditional seal assemblies, the corner **66** may facilitate leakage between the first component **50** and the second component **80** because traditional sealing devices (e.g., laminates and/or shims) are substantially planar, and thus not able to fully conform to and seal the corner **66**. Further, a conjoined intersegment seal (e.g., two or more laminate seals connected to one another) may still incur a relatively large amount of leakage at ends of the seal slot because of manufacturing and assembly tolerances (e.g., the conjoined intersegment seal has a length less than the seal slot so that it may fit within the seal slot).

As shown in the illustrated embodiment of FIG. **4**, the seal assembly **56** includes an upstream corner shim **132** (e.g., a first corner shim) and a downstream corner shim **134** (e.g., a second corner shim). As used herein, a "corner shim" may include a sealing device that may include two or more members (e.g., planar pieces of material) connected by one or more corners (e.g., a joint between two members). In some embodiments, the upstream corner shim **132** and/or the downstream corner shim **134** may include a high temperature alloy material such as nickel-based alloys, titaniumbased alloys, and/or cobalt-based alloys. Additionally, the upstream corner shim **132** and/or the downstream corner shim **134** may include a thickness of between 1 millimeter (mm) and 20 mm, 2 mm and 15 mm, or 8 mm and 12 mm.

In certain embodiments, the upstream corner shim **132** may be positioned proximate to the upstream portion **126** and the downstream corner shim **134** may be positioned proximate to the downstream portion **128** (e.g., the downstream corner shim **134** is positioned farther along the direction **130** than the upstream corner shim **132**). When the upstream corner shim **132** and the downstream corner shim **134** are disposed in the seal slot **120**, a first end gap **136** may be formed in the vertical portion **122** and a second end gap **138** may be formed in the horizontal portion **124**. The end gaps **136**, **138** may form as a result of manufacturing and/or assembly tolerances that limit a size of the upstream corner shim **132** and the downstream corner shim **134**. For example, the upstream corner shim **132** and the downstream corner shim **134** may be sized to form the gaps **136** and **138** to ensure that the upstream corner shim **132** and the downstream corner shim **134** may fit within the seal slot **120**. However, the end gaps **136** and **138** may be undesirable because fluid may flow from the upstream portion **126** toward the downstream portion **128** through the first end gap **136** and/or the second end gap **138**. It is now recognized that features may be included in the upstream corner shim **132** or the downstream corner shim **134** to substantially cover the end gaps **136** and/or **138**, and thus, reduce an amount of leakage from the upstream portion **126** to the downstream portion **128**.

For example, the upstream corner shim **132** or the downstream corner shim **134** may include a pressure actuation feature **140**. In the illustrated embodiment of FIG. **4**, the upstream corner shim **132** includes the pressure actuation feature **140**. However, it should be recognized that the downstream corner shim **134** may include the pressure actuation feature **140** in other embodiments. The upstream corner shim **132** may include a vertical portion **142** and a horizontal portion **144** that are disposed in the vertical portion **122** and the horizontal portion **124** of the seal slot **120**, respectively. In accordance with some embodiments of the present disclosure, the pressure actuation feature **140** may be a first deformable feature **146** of the vertical portion **142** and a second deformable feature **148** of the horizontal portion **144**. As used herein a “deformable feature” may be a portion of the upstream corner shim **132** or the downstream corner shim **134** that is angled from a base portion **149** of the vertical portion **142** and/or the horizontal portion **144**. The deformable features **146**, **148** may be configured to be “deformed” when a pressure force in the upstream portion **126** exceeds a threshold, thereby causing the deformable features **146**, **148** to flatten and/or compress. In some embodiments, when the pressure force is removed, the deformable features **146**, **148** may return to the angled position from the base portion **149** (e.g., the deformable features **146**, **148** are reversible). In other embodiments, the deformable features **146**, **148** may remain in a flattened position even when the pressure force is removed (e.g., the deformable features **146**, **148** are irreversible).

The first deformable feature **146** of the vertical portion **142** and the second deformable feature **148** of the horizontal portion **144** may be configured to substantially cover the end gaps **136** and/or **138**, thereby blocking fluid leakage between the first component **50** and the second component **80** via the gaps **136** and/or **138**. For example, as pressure builds in the upstream portion **126**, the first deformable feature **146** may be directed in a first direction **150** such that the first deformable feature **146** flattens, thereby increasing a first length **152** of the vertical portion **142** to substantially cover the first end gap **136**. Similarly, as the pressure builds in the upstream portion **126**, the second deformable feature **148** may be directed in a second direction **154** such that the second deformable feature **148** flattens, thereby increasing a second length **156** of the horizontal portion **144** to substantially cover the second end gap **138**. Accordingly, the first length **152** and the second length **156** may enable the upstream corner shim **132** to be disposed in the seal slot **120** during assembly, however, when the deformable features **146** and/or **148** flatten, the increase in length may cause the upstream corner shim **132** to exceed tolerance levels of the seal slot **120**. Thus, the deformable features **146** and **148** enable the upstream corner shim **132** to cover the gaps **136** and **138**, while adhering to manufacturing and/or assembly tolerance specifications.

In some embodiments, the first deformable feature **146** may be a predetermined percentage of the vertical portion **142**. For example, the first deformable feature **146** may be between 1% and 75% of the vertical portion **142**, between 2% and 55% of the vertical portion **142**, between 3% and 50% of the vertical portion **142**, or any combination thereof. Similarly, the second deformable feature **148** may be a predetermined percentage of the horizontal portion **144**. For example, the second deformable feature **148** may be between 1% and 75% of the horizontal portion **144**, between 2% and 55% of the horizontal portion **144**, between 3% and 50% of the horizontal portion **144**, or any combination thereof. In other embodiments, the first deformable feature **146** and/or the second deformable feature **148** may be any suitable percentage of the vertical portion **142** and the horizontal portion **144**, respectively, such that the first deformable feature **146** and/or the second deformable feature **148** may substantially cover the end gaps **136** and **138** to block leakage of fluid between the components **50** and **80**.

The illustrated embodiment of FIG. **4** shows the upstream corner shim **132** having the pressure actuation feature **140**, where the pressure actuation feature **140** includes the first deformable feature **146** and the second deformable feature **148**. However, the pressure actuation feature **140** may include other configurations, such as those shown in the embodiments of FIGS. **5** and **6**. For example, FIG. **5** is a block diagram of the seal assembly **56** disposed in the seal slot **120** and having a corrugated pressure actuation feature **170**. As shown in the illustrated embodiment of FIG. **5**, the upstream corner shim **132** includes a corrugated vertical portion **172** and a single-corrugated horizontal portion **174**. As discussed above, as pressure may build in the upstream portion **126**, which may eventually lead to fluid leakage through the end gaps **136** and/or **138**. Accordingly, the corrugated vertical portion **172** and/or the single-corrugated horizontal portion **174** may be utilized to substantially cover the end gaps **136** and/or **138**, thereby blocking fluid flow through the end gaps **136** and/or **138**.

For example, when pressure builds in the upstream portion **126**, a first force **176** may be applied to the corrugated vertical portion **172** and/or a second force **178** may be applied to the single-corrugated horizontal portion **174**. In some embodiments, the first force **176** and the second force **178** may be applied simultaneously. In other embodiments, pressure from the upstream portion **126** may apply the first force **176** and the second force **178** separately. In any case, the corrugated vertical portion **172** may be configured to collapse (e.g., compress and/or flatten) when the first force **176** exceeds a first threshold biasing force of the corrugated vertical portion **172**. Similarly, the single-corrugated horizontal portion **174** may be configured to collapse (e.g., compress and/or flatten) when the second force **178** exceeds a second threshold biasing force of the single-corrugated horizontal portion **174**. In some embodiments, the first and/or second threshold biasing forces may correspond to a flow rate of fluid between the first and second components **50**, **80** that may reduce a performance of the turbine system **10** beyond a predetermined tolerance level. Accordingly, when the first and/or second biasing forces are exceeded by the first and/or second forces **176**, **178**, the vertical corrugated portion **172** and/or the single-corrugated horizontal portion **174** may collapse (e.g., compress and/or flatten), thereby increasing a third length **179** of the vertical portion **142** and/or a fourth length **180** of the horizontal portion **144**, respectively. In accordance with present embodiments, increasing the third length **179** and/or the fourth length **180** may substantially cover the first end gap **136** and/or the second end gap **138**, thereby substantially blocking the flow of gas between the first and second components **50**, **80**.

In some embodiments, collapsing (e.g., compressing and/or flattening) the corrugated vertical portion **172** and/or the single-corrugated horizontal portion **174** may be reversible. In such embodiments, when the first force **176** and/or the second force **178** no longer exceed the first and second threshold biasing forces, respectively, the corrugated vertical portion **172** and/or the single-corrugated horizontal portion **174** may be configured to return to a position that leaves the gaps **136** and/or **138** uncovered. In other embodiments, when the corrugated vertical portion **172** and/or the single-corrugated horizontal portion **174** collapse, they may remain collapsed (e.g., collapsing may be irreversible).

As shown in the illustrated embodiment of FIG. **5**, the corrugated vertical portion **172** includes a single curved portion **181**. In certain embodiments, the single curved portion **181** includes a height **182** that is less than a thickness **184** of the vertical portion **122** of the seal slot **120**. In other embodiments, the height **182** of the curved portion **181** may be substantially equal to the thickness **184** of the vertical portion **122**. Similarly, the single-corrugated horizontal portion **174** includes a first curved portion **186** and a second curved portion **188** separated by a single kink **189**. The first curved portion **186** includes a first height **190** and the second curved portion **188** includes a second height **192**. As shown in the illustrated embodiment of FIG. **5**, the first height **190** and the second height **192** are both less than a thickness **194** of the horizontal portion **124** of the seal slot **120**. However, in other embodiments, the first and second heights **190**, **192** may be substantially equal to the thickness **194** of the horizontal portion **124**. Additionally, the first height **190** and the second height **192** may be substantially equal or different. It should be noted that the first height **190** and the second height **192** may at least partially define the second threshold biasing force. Accordingly, the first height **190** and the second height **192** may be configured to such that the second threshold biasing force is at a suitable level to enable the single-corrugated horizontal portion **174** to collapse when leakage may occur through the second end gap **138**.

In the illustrated embodiment of FIG. **5**, the vertical corrugated portion **172** includes the single curved portion **181**. However, in other embodiments, the vertical corrugated portion **172** may include any suitable number of curved portions to enable the vertical corrugated portion **172** to collapse when a pressure force exerted by the fluid in the upstream portion **126** exceeds the first threshold biasing force. Additionally, the single-corrugated portion **174** of the upstream corner shim **132** includes the first curved portion **186** and the second curved portion **188** separated by the single kink **189**. However, in other embodiments, the horizontal portion **144** of the upstream corner shim **132** may include more than two curved portions (e.g., more than one kink), a single curved portion, or features in addition to curved portions.

For example, FIG. **6** is a block diagram of an embodiment of the seal assembly **56** disposed in the seal slot **120** having the vertical corrugated portion **172** and a dual-corrugated horizontal portion **210**. As shown in the illustrated embodiment of FIG. **6**, the dual-corrugated horizontal portion **210** may include the first curved portion **186** and the second curved portion **188** separated by a first kink **212**. In addition, the dual-corrugated horizontal portion **210** includes a deformable feature **214** separated from the second curved portion **188** by a second kink **216**.

As shown in the illustrated embodiment of FIG. **6**, the first curved portion **186** may include a third height **218** and the second curved portion **188** may include a fourth height **220**. The third height **218** and the fourth height **220** may determine a length **222** of the deformable feature **214** and/or a distance **224** between the first kink **212** and the second kink **216**. In some embodiments, the third height **218**, the fourth height **220**, the length **222**, and/or the distance **224** between the first and second kinks **212**, **216** may determine a third threshold biasing force. When the second force **178** exceeds the third threshold biasing force, the dual-corrugated horizontal portion **210** may be configured to collapse (e.g., compress and/or flatten) such that the dual-corrugated horizontal portion **210** increases in length to substantially cover the gap **138**. In some embodiments, the third biasing force may correspond to a flow rate of fluid between the first and second components **50**, **80** that may reduce performance of the system **10** beyond a predetermined tolerance level. Accordingly, the third height **218**, the fourth height **220**, the length **222**, and/or the distance **224** of the dual-corrugated horizontal portion **210** may be configured such that an appropriate third threshold biasing force is exerted by the dual-corrugated horizontal portion **210**.

To manufacture the turbine system **10** that includes embodiments of the seal assembly **56** described in the present disclosure, a process **240** may be performed, as shown in FIG. **7**. For example, at block **242**, the first portion **57** of the seal assembly **56** may be disposed in the first seal slot **54** of the first component **50**. As discussed above, in certain embodiments the seal assembly **56** may include the upstream corner shim **132** and the downstream corner shim **134** when the first seal slot **54** includes the "L" shape (e.g., has a first segment and a second segment joined by a first corner). Additionally, either the upstream corner shim **132** or the downstream corner shim **134** may include the pressure actuation feature **140** (e.g., the deformable features, the single-corrugated portion, and/or the dual-corrugated portion). Although the discussion of FIG. **5** focuses on the seal slot **54** (and the second seal slot **82**) having an "L" shape, it should be recognized that the seal assembly **56** may be configured to be disposed in any suitable seal slots **54** and/or **82** to substantially block the fluid from flowing through the gap **84** formed between the first component **50** and the second component **80**.

At block **244**, the second portion **58** of the seal assembly **56** may be disposed in the second seal slot **82** of the second component **80**. Accordingly, at block **246**, the first component **50** may be coupled to the second component **80** (e.g., via a fastener such as a screw, a rivet, a clamp, or another securement device). In some embodiments, the steps described in blocks **244** and **246** may occur simultaneously. In other embodiments, the step described in block **246** may occur either before or after the step described in block **244**. When the second portion **58** of the seal assembly **56** is disposed in the second seal slot **82**, the gap **84** between the first component **50** and the second component **80** may be sealed, such that the fluid flowing between the components **50**, **80** is blocked by the seal assembly **56**. Moreover, the pressure actuation feature **140** included in the upstream corner shim **132** or the downstream corner shim **134** may enhance the seal between the components **50**, **80**. For example, the seal assembly **56** may block fluid from flowing through the corner **66** as well as through the end gaps **136** and **138**. When the pressure in the gap **84** exceeds the threshold biasing force of the pressure actuation feature **140**, the pressure actuation feature **140** may collapse (e.g., compress and/or flatten), thereby increasing a length of the upstream shim **132** or the downstream shim **134** to substantially cover the end gaps **136** and **138**. Therefore, the seal assembly **56** may provide an enhanced seal between the first and second components **50**, **80**, thereby enhancing the efficiency of the turbine system **10**.

Technical effects of the invention include a sealing assembly disposed between components of a turbomachine that may enhance an efficiency of the turbomachine. In accordance with embodiments of the present disclosure, the sealing assembly may include an upstream corner shim and a downstream corner shim, where one of the upstream corner shim or the downstream shim includes a pressure actuation feature. The pressure actuation feature may be configured to increase a length of one or more portions of the shim such that end gaps formed due to manufacturing tolerances are substantially covered when a pressure between turbine components exceeds a threshold level. In certain embodiments, the pressure actuation feature may include a deformable feature of the shim, a single-corrugated shim, a dual-corrugated shim, or any combination thereof. Such a seal assembly may block a flow of gas between the components, and specifically, block the flow of gas through corners and/or ends of a seal slot configured to receive the seal assembly, which may ultimately enhance an efficiency of the turbomachine

This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

The invention claimed is:

1. A turbomachine comprising:

a first component comprising a first seal slot with a first corner;

a second component coupled to the first component, wherein the second component comprises a second seal slot with a second corner;

a gap between the first component and the second component; and

a seal assembly disposed in the first component, the second component, and a portion of the gap, wherein the seal assembly comprises a first corner shim and a second corner shim, and wherein each of the first corner shim and the second corner shim include two or more members connected by one or more corners and the first corner shim comprises a pressure actuation feature configured to cover end gaps in the first seal slot, the second seal slot, or both when a pressure in the gap exceeds a threshold biasing force of the pressure actuation feature.

2. The turbomachine of claim **1**, wherein the first corner shim comprises a first portion and a second portion.

3. The turbomachine of claim **2**, wherein the pressure actuation feature comprises a first deformable feature of the first portion and a second deformable feature of the second portion.

4. The turbomachine of claim **3**, wherein the first deformable feature is between 3% and 50% of the first portion and the second deformable feature is between 3% and 50% of the second portion.

5. The turbomachine of claim **1**, wherein the pressure actuation feature comprises a first corrugated portion of the first corner shim and a single-corrugated portion of the first corner shim.

6. The turbomachine of claim **5**, wherein the single-corrugated portion comprises a first curved portion and a second curved portion separated by a single kink.

7. The turbomachine of claim **1**, wherein the pressure actuation feature comprises a first corrugated portion of the first corner shim and a dual-corrugated portion of the first corner shim.

8. The turbomachine of claim **7**, wherein the dual-corrugated portion of the first corner shim comprises a first kink and a second kink.

9. The turbomachine of claim **8**, wherein the dual-corrugated portion comprises a first curved portion, a second curved portion, and a deformable feature, the first curved portion and the second curved portion are separated by the first kink, and the second curved portion and the deformable feature are separated by the second kink.

10. The turbomachine of claim **1**, wherein the threshold biasing force is configured to be substantially equal to a pressure force corresponding to the fluid flowing through the end gaps.

11. A power generation system, comprising:

a turbomachine;

a first component of the turbomachine comprising a first seal slot, wherein the first seal slot comprises a first segment and a second segment coupled to one another by a first corner;

a second component of the turbomachine coupled to the first component, wherein the second component comprises a second seal slot, and the second seal slot comprises a third segment and a fourth segment coupled to one another by a second corner;

a gap between the first component and the second component; and

a seal assembly positioned in the first seal slot, the second seal slot, and a portion of the gap, wherein the seal assembly comprises:

a first corner shim positioned in the first segment, the second segment, the third segment, and the fourth segment; and

a second corner shim positioned in the first segment, the second segment, the third segment, and the fourth segment, wherein each of the first corner shim and the second corner shim include two or more members connected by one or more corners and the second corner shim comprises a pressure actuation feature configured to cover end gaps in the first seal slot, the second seal slot, or both when a pressure in the gap exceeds a threshold biasing force of the pressure actuation feature.

12. The turbomachine of claim **11**, wherein the first corner shim comprises a first portion and a second portion.

13. The turbomachine of claim **12**, wherein the pressure actuation feature comprises a first deformable feature of the first portion and a second deformable feature of the second portion.

14. The turbomachine of claim **11**, wherein the pressure actuation feature comprises a first corrugated portion of the first corner shim and a single-corrugated portion of the first corner shim.

15. The turbomachine of claim **11**, wherein the pressure actuation feature comprises a first corrugated portion of the first corner shim and a dual-corrugated portion of the first corner shim.

16. The power generation system of claim **11**, wherein the threshold biasing force is configured to be substantially equal to a pressure force corresponding to the fluid flowing through the end gaps.

17. A method, comprising:

disposing a first portion of a seal assembly in a first seal slot of a first component of a turbomachine, wherein the seal assembly comprises a first corner shim and a second corner shim, and wherein each of the first corner shim and the second corner shim include two or more members connected by one or more corners and the first corner shim comprises a pressure actuation feature;

disposing a second portion of the seal assembly in a second seal slot of a second component of the turbomachine; and

coupling the first component to the second component to form a gap between the first component and the second component, wherein the pressure actuation feature is configured to cover end gaps in the first seal slot, the second seal slot, or both when a pressure in the gap exceeds a threshold biasing force of the pressure actuation feature.

18. The method of claim **17**, comprising forming the pressure actuation feature by bending a first portion of the first corner shim to form a first deformable feature of the first portion and bending a second portion of the first corner shim to form a second deformable feature of the second portion.

19. The method of claim **17**, wherein the pressure actuation feature comprises a first corrugated portion of the first corner shim and a single-corrugated portion of the first corner shim.

20. The method of claim **17**, wherein the pressure actuation feature comprises a first corrugated portion of the first corner shim and a dual-corrugated portion of the first corner shim.

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